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Brief Report

Environmental Exposure to Libby Asbestos and Mesotheliomas

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Background Thirty-one cases of mesothelioma resulting from exposure to Libby Asbestos have been identified from Libby, Montana. Eleven cases not previously reported are the subject of this report.

Methods These cases are in non-occupationally exposed people, appearing to have resulted from exposure to contamination of the community, the surrounding forested area, and areas in proximity to the Kootenai river and railroad tracks used to haul vermiculite.

Results These exposures are considered to be of a low degree of magnitude, but are similar to those in Western Australia's crocidolite mine at Wittenoom Gorge. An epidemic of mesothelioma can likely be expected from this type of asbestos contamination over the next 20 plus years. Am. J. Ind. Med. 2008. © 2008 Wiley-Liss, Inc.

KEY WORDS: tremolite; winchite; richterite; mesothelioma; asbestos; pleural cancer; asbestos pleural disease; vermiculite; Libby

INTRODUCTION

McDonald et al. [2004] described 12 confirmed cases of mesothelioma occurring before 1998 in former employees of the W.R. Grace Company (WRG). The company operated the world's largest vermiculite mine near Libby, MT, from 1963 to 1990. The mine was operated by the original Zonolite Corporation from the 1920s until purchased by W.R. Grace in 1963. The vermiculite ore bed was contaminated with up to

26% amphibole asbestos, originally believed to be tremolite; but more recent analysis indicates the asbestos is a combination of 84% winchite, 11% richterite and 6% tremolite [Meeker et al., 2003]. Agency for Toxic Substances and Disease Registry (ATSDR) documents confirmed contamination of the town of Libby, MT, along the Kootenai River and the surrounding environment [ATSDR, 2000]. Vermiculite ore was given by WRG free of charge to the people of Libby and was extensively used in gardens, driveways, little league ball fields, and the high school track. Expanded vermiculite (Zonolite) insulation was used extensively in the lumber mill. Many attics and walls of homes in Libby are insulated with vermiculite. The finished vermiculite product contains 2–6% asbestos [Amandus et al., 1987]. Cases of pleural disease among people exposed only environmentally (non-occupationally) have been documented previously by ATSDR [2002]. Environmental levels of asbestos recorded by WRG in 1975 ranged from 1.0 to 1.5 fibers/ml air, [Grace, 1975]. Sullivan [2007] reported that 15 cases of mesothelioma were documented in WRG workers as of 2001. We report an additional 11 cases of mesothelioma that have been documented among non-occupationally exposed people by the Center for Asbestos Related Disease (CARD) in Libby.

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METHODS

The Center for Asbestos Related Disease in Libby, MT, serves as a focal point for diagnosis and treatment of asbestos-related diseases in the region. CARD has become aware of 15 cases of malignant mesothelioma since 1995 that were not included in the studies by McDonald et al. and Sullivan noted above. These cases include four WRG employees (details not reported here), two family members of WRG workers and nine purely environmental cases among Libby residents. The two family cases and nine environmental cases have appeared since 1995 and were treated at the CARD clinic or by one of the coauthors of this report. The additional four cases were reported to the authors by current or former residents of Libby. Occupational and environmental exposure histories were obtained from the patients and CARD records and supplemented by next-of-kin. The exposure history of Case 5 was obtained from the patient's widow only. Family physicians were contacted to obtain pathology reports, death certificates and any other pertinent information that was not available at CARD. Pathology reports of biopsies were obtained on all subjects except one case.

RESULTS

The details regarding the clinical and exposure status of the two family contact cases and nine environmental exposure cases are described below and in Table I.

Case 1: This 65-year-old male lived in Libby from 1941 to 1959. His father worked at the Zonolite facility throughout that time period. He also had possible exposure to asbestos as a construction worker for many years, but worked mainly in residential construction and was uncertain about the extent of contact with asbestos-containing materials on the job. Zonolite was used in the garden and attic of his childhood home in Libby. His mesothelioma was diagnosed in 2006. He is alive as of this writing.

Case 2: A 52-year-old woman died in 2003 of peritoneal mesothelioma diagnosed in 2000. She was employed at a private medical and dental office in Libby from 1971 to 1983. She reported that her car was covered with dust on a daily basis after work. Her workplace was 5 miles southwest of the WRG mine and 1 mile north of Libby. Many of the patients where she worked were WRG employees who were seen after a work shift. She had no other known exposure to asbestos.

TABLE I. Exposure and Pathology Data on 11 Cases of Mesothelioma, Libby, Montana

Case number	Sex	Age/year at diagnosis	Year of death	Year of initial exposure	Number of years since initial exposure	Calendar years of exposure (years)	Duration of exposure (years)	Source(s) of exposure	Pathology ^a
1	M	65/2006	Alive	1941	65	1941–1959	18	Resident/Family/Construction trades	Epithelial
2	F	52/2000	2003	1971	29	1971–1985	17	Resident	Epithelial(p) ^b
3	M	71/1993	1995	1980	13	1980–1986	6	Resident	
4	F	48/1999	2000	1963	36	1963–1965	2	Family/Aluminum Plant	Epithelial
5	M	81/2003	2004	1960	44	1960–unknown, 1994–2004	10+	Resident/Recreation/US Coast Guard/Carpenter	Epithelial
6	F	48/1996	1998	1944	52	1944–1998	54	Resident	Epithelial
7	M	70/1998	1998	1945	67	1931–1998	67	Resident	Epithelial
8	M	82/2002	2002	1960	42	1960–1970	10	Resident	Epithelial
9	F	59/1995	Alive	1973	22	1973–2007	34	Resident	Epithelial
10	F	79/2002	2002	1950	52	1950–2002	52	Resident	Epithelial
11	M	72/2000	2002	1968	34	1968–1976, 1984–2002	26	Resident	Epithelial

^aAll were pleural mesothelioma except # 2 (peritoneal mesothelioma).

^bNot available due to 13 years hiatus since death.

Case 3: This 71-year-old male was diagnosed with mesothelioma in 1993 and died of the disease in 1995. He lived in Libby for 6 years from 1980 to 1986. He had one guided tour of the WRG mine, but otherwise had no other known exposure to asbestos other than by virtue of his residence in Libby. He was an office employee of the forest service, and his father did not live or work in Libby. His wife has asbestos-related pleural disease, again following only residential exposure. His personal physician provided medical records documenting the diagnosis, but the original pathology report was lost so the cell type could not be determined.

Case 4: This female died in 2000 at the age of 49 of mesothelioma diagnosed in 1999. She lived approximately 100 miles east of Libby. Her father worked at the Zonolite mine from 1963 to 1965 and came home on weekends, when the patient laundered his work clothes. Her father also worked intermittently at an aluminum plant in Columbia Falls, MT, which may have entailed exposure to asbestos.

Case 5: This elderly male was age 81 at the time of his diagnosis. The patient lived in eastern Washington and vacationed in Libby nearly every summer in the 1960s to fish on the Kootenai River downstream a short distance from the vermiculite transfer site: the WRG conveyor extending across the river from the screening plant to the rail loading yards. He ultimately moved to Libby in the mid-1990. The diagnosis of mesothelioma was made in 2003, and he died in 2004. He also may have had exposure to asbestos in the US Coast Guard at the end of WWII. As a lifelong carpenter, he is likely to have had exposure to asbestos in his work. Relevant to his exposure in Libby, it is of use to note his widow has developed diffuse calcified pleural thickening and had no identifiable exposure to asbestos except during her residence in Libby.

Case 6: A 48-year-old woman who lived lifelong in Libby died in 1998 of mesothelioma, diagnosed 2 years previously. She lived near the contaminated ball fields and railroad tracks, played as a child on piles of vermiculite ore, and popped vermiculite on the stove. Zonolite insulation was in the ceiling of the home where she lived during the last 25 years of her life.

Case 7: This was a male who was diagnosed at age 68 and died at age 70 in 1998. He worked for the railroad, sealing railcars leaving Zonolite facilities in 1945 and 1946. He lived next to the expansion plant from 1954 to 1956 and had Zonolite in the garden and attic. From 1976 to 1981, he worked in a bowling alley, which WRG workers frequented after work.

Cases 8: This elderly man was diagnosed and died of mesothelioma in 2002, at age 82. He lived in Libby for 10 years from the early 1960s, across the Kootenai River from the expansion and bagging plant. He had no other known exposure to asbestos.

Case 9: This 71-year-old female was diagnosed with mesothelioma in 1995 and re-biopsied in 2002 to confirm the diagnosis because of unusually long survival and responsiveness to chemotherapy. She remains alive in 2007. She lived 40 miles outside of Libby, but shopped in Libby and came into town frequently from 1973 to 1987. She spent approximately 300 days in Libby during that period. She had no other identifiable exposure to asbestos.

Case 10: A 79-year-old woman, a school nurse, died of mesothelioma in 2002. She lived in Libby from 1950 until her death. She worked as a school nurse for the school district for many years. Her husband was a forester who may have been exposed to asbestos.

Case 11: This 72-year-old male lived near Libby along the Kootenai River about 2 miles below the screening plant and conveyor. He worked at Libby Dam and drove past the screening plant daily from 1973 to 1976. He died of mesothelioma in 2002. He had no other known exposure to asbestos.

Table I lists age, exposures, and mesothelioma cell type for each case.

The range of latency of these cases is 13–67 years from first known exposure to asbestos in Libby. The youngest patient in this series was 48 years of age at diagnosis.

DISCUSSION

Mesothelioma has been shown to occur in family members of asbestos workers as well as in people living near asbestos facilities. Wagner et al. [1960] described 33 cases of mesothelioma in South Africa; 12 of whom appeared to be environmental in origin. Newhouse and Thompson [1965] reported 36 cases of mesothelioma occurring in London in an area around an asbestos factory. By 2002, the Australian mesothelioma registry documented 203 cases with no known history of asbestos exposure; but with very careful histories, 57 of those were discovered to have some history of exposure. Nineteen percent of the 203 had no exposure history that could be identified [Leigh and Driscoll, 2003]. Overall, 81% of the 203 had high asbestos fiber counts in tissue specimens [Leigh and Driscoll, 2003], suggesting prior environmental exposures.

ATSDR has documented environmental exposures causing asbestos-related pleural disease among Libby residents [ATSDR, 2002]. Cases of mesothelioma attributable to environmental exposures in Libby have been identified only since 1995; a considerable period after the severe pleural and parenchymal disease secondary to asbestos exposure was described in WRG workers [Amandus et al., 1987].

The background rate of mesothelioma is described as 1 case per million person years [Roggli et al., 1998]. The 9 environmental and 2 household-exposed cases described herein are in excess of expected, given the population of Central Lincoln County of 9,521 [Peipins et al., 2003]. Eleven cases is probably an underestimate of the true number

of malignant mesotheliomas for many reasons including the inability to follow the many workers on the Libby dam project from 1966 to 1974 (1 mile northeast of the mine) who had had significant exposure and who had left Libby after completion of the dam, as well as the large numbers of employees of the lumber mill (approximately 1,200), who were frequently transitory workers. For the above reasons and the failure to learn of all mesothelioma cases in people who left Libby, mesothelioma rates based on currently identified cases can only be considered an underestimate.

The closest comparison to the Libby setting is the mesothelioma experience of the Wittenoom Gorge crocidolite mine in Western Australia. The blue asbestos mine operated from 1943 to 1966. As of 2002, 254 cases of mesothelioma have been reported in mine workers and residents of the town [Reid et al., 2007]. Sixty-seven cases are reported among Wittenoom residents who were not miners [Reid et al., 2007], representing a mix of family and residential environmental cases.

The estimated exposure for Wittenoom residents was 1.0 fibers/ml in ambient air from 1943 to 1957 and 0.5 fibers/ml ambient air in 1996. WRG measured 1.1 fiber/ml at the hospital in downtown Libby and 1.5 fibers/ml near the lumber mill and railyards in 1975 [Grace, 1975]. Those levels were obtained with phase contrast microscopy; no other details are known. Wittenoom town exposures appear on the surface to be of a similar magnitude as experienced by the 11 recent cases reported here from Libby. Wittenoom mine closed around 1966, near the time WRG began large scale production in Libby [1963]. Exposure to Libby asbestos of unknown magnitude continued past 1990. The latency period for mesotheliomas attributable to environmental exposures in Libby has therefore not nearly been completed and the extent of the epidemic of environmental mesothelioma due to exposures based at Libby will probably not peak for another 10–20 years. This is a public health problem of considerable magnitude and points to the need for surveillance and early detection of the disease, in the hope that the mortality from mesothelioma in Libby can be reduced.

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